The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board

Paper No. 22

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KARL A. LITTAU,
CHILIANG L. CHEN and
ANAND VASUDEV

Appeal No. 2001-2067
Application No. 08/893,917

ON BRIEF

Before KRATZ, JEFFREY SMITH and PAWLIKOWSKI, Administrative Patent Judges.

PAWLIKOWSKI, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 1-21, which are all of the claims pending in this application.

The subject matter on appeal is represented by claims 1-21. A copy of claims 1-21 is set forth in the attached appendix.

The examiner relies upon the following references as evidence of unpatentability:

Stevens et al. (Stevens)	5,302,803	Apr. 12, 1994
Kawamura	5,328,558	July 12, 1994
Moslehi	5,403,434	Apr. 4, 1995

Claims 1-4, 6, 8, 9, 11-15, and 21 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Kawamura.

Claims 1-15, and 21 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Moslehi.

Claims 16-20 stand rejected under 35 U.S.C. § 103 as being unpatentable over Kawamura or Moslehi in view of Stevens.

Appellants group the claims as set forth on pages 4-5 of the brief. We consider each of these groupings in this appeal. 37 CFR § 1.192(c)(7)(8)(2000).

We have carefully considered the entire record in light of the opposing arguments presented on appeal. Having done so, we conclude that the examiner has established a prima facie case of obviousness with respect to claims 1 through 7, and 21. However, with respect to claims 8 through 15, because the examiner has failed to provide his interpretation of the scope of these claims pursuant to 35 U.S.C. § 112, paragraph 6, and because the examiner has failed to provide a comparison of such an interpretation with the applied art, we remand the application to the examiner for an appropriate analysis, and we refer to our discussion below in this regard. With respect to claims 16-20, because the examiner has failed to conduct a proper comparison with each element of these claims and the applied art, we also remand the application to the examiner for a proper analysis.

OPINION

I. The rejection of claims 1-4, 6, 8, 9, 11-15, and 21 under 35 U.S.C. § 102(b) as being anticipated by Kawamura

On page 8 of the brief, appellants argue that, in Kawamura, the NF_3/H_2 is activated by plasma to produce activated F^*, H^*, and N^* species, which are flowed into the chamber. Appellants state that the flow of the plasma activated species is stopped by closing valves 36 and 38, and then valve 50 for the Ar gas is opened to feed the Ar gas into the chamber. Appellants state that therefore there is no mixing of a flow of reactive radicals and a nonplasma diluent gas flow anterior of the chamber to form a gas-radical mixture. On pages 4-5 of the answer, the examiner does not respond to this particular argument.

Upon our review of Kawamura, we find that Kawamura discloses that the NF_3/H_2 mixture is used as a feed gas for the etchant, and the activated species are introduced down pipe 32. See column 4, lines 13-42. In another embodiment, the activated species are supplied, and then stopped, then an Ar gas is introduced as plasma or ions into buffer chamber 30. See column 5, lines 65-68 and column 6, lines 1-42. The Ar inert gas plasma or ions are directed to, from above, the activated species that have been absorbed on and in the SiO_2. See column 6, lines 30-33. We note that appellants' claim 1 requires the mixing of reactive radicals and diluent gas, and flowing the resultant mixture into a chamber. Here, in Kawamura, the reactive radicals are already absorbed before the Ar gas is introduced. It therefore appears that the recited step of flowing the resultant mixture into the chamber is not met by Kawamura.

Because the examiner has not shown that this aspect of appellants' claims is met by Kawamura, we determine that Kawamura does not anticipate claim 1 in this regard.

We note that claims 1 and 21 are method claims, whereas claims 8 and 16 are apparatus claims (claim 16 is addressed later in this opinion in connection with the Section 103 rejection in section III of this opinion). Our determination with regard to claim 21 is the same as our determination with regard to claim 1. Our determination with regard to claim 8 is set forth below.

We note that absent structure capable of performing the functional limitations of the means being claimed, the prior art cannot meet the claims. In re Mott, 557 F.2d 266, 269, 194 USPQ 305, 307 (CCPA 1977). We also note that in determining the scope of appellants' claim 8, 35 U.S.C. § 112, paragraph 6 provides that an element in a claim for a combination may be expressed as a means or step, for performing a specified function, without the recital of structure, material, or acts in support thereof, and requires that such a claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof. Also, when the terms in the claims are written in a "means-plus-function" format, one interprets them as the corresponding structure described in the specification or the equivalents thereof consistent with 35 U.S.C. § 112, paragraph 6. In re Donaldson, 16 F.3d 1189, 1193, 29 USPQ 1845, 1848 (Fed. Cir. 1994)(en banc). Once the scope of the claim is determined by the examiner, the examiner must then make a comparison between the scope of the claim (with respect to every claimed element) and the teachings of the applied art

to determine whether a prima facie case is set forth in the applied art.

We have carefully reviewed the Office Action of Paper No. 11 (mailed March 3, 2000) and the answer, and we are unable to find the examiner's interpretation of the scope of claim 8 pursuant to 35 U.S.C. § 112, paragraph 6, and we are also unable to find a comparison of such with the applied art of Kawamura. Hence, we **remand** this application to the examiner for an appropriate analysis in this regard.

In view of the above, we **reverse** the rejection of claims 1-4, 6, and 21, and **remand** the application to the examiner with respect to claims 8, 9, and 11-15.

II. The rejection of claims 1-15, and 21 under 35 U.S.C. § 102(b) as being anticipated by Moslehi

We first consider method claims 1 and 21 in this rejection.[1]

It is the examiner's position that the anterior mixing point in Moslehi's apparatus is within discharge cavity 28 as noted from the "T" joining plasma and nonplasma gases. The examiner states that the mixing point is separated from, and thus anterior to, processing chamber 14. (answer, pages 5 and 7, office action of Paper No. 11, pages 3-4).

Appellants argue that either both the digermane gas and additives, and the inert gases, flow through the plasma gas tube 24 to produce a remote plasma stream of gases into the chamber, or the non-plasma digermane gas and additives are introduced into the afterglow of the inert gas plasma

[1]We are mindful of appellants' grouping of the claims made on pages 4-5 of the brief. We particularly note that appellants have grouped claims 1-3 and 6 together and therefore we only consider claim 1 of this particular grouping (claims 1-3 and 6).

discharge in the chamber. (brief, page 8, reply brief, page 2).

We find that discharge cavity 28 is depicted in Figure 1 of Moslehi. Moslehi discloses a distribution network 20 that includes multiple mass-flow controllers for various process gases, including, but not limited to, digermane, hydrogen, HCl/HBr, HF, argon, and dichlorosilane. See Figure 1 and column 9, lines 1-5. In column 9, beginning at line 6, Moslehi discloses that microwave source 26 and discharge cavity 28 are used to provide a remotely generated plasma stream for gases injected via plasma gas manifold 24. Moslehi discloses that plasma activation can be achieved by injecting a remote plasma stream of H_2, Ar/He (or other inert gas such as He or Xe), or an H_2 + Ar/He mixture.[2] Moslehi discloses that generally, "**while some of all of the digermane gas and the HCl/HBr and HF additives can also be introduced in the plasma stream**, these components of the cleaning process stream are introduced as downstream nonplasma gases".[3] [emphasis added] See column 14, lines 37-44. This disclosure indicates that in fact the digermane gas and additives can be mixed with the plasma stream before this mixture is introduced into the chamber via plasma gas manifold 24. Appellants acknowledge this to be so because, as mentioned supra, appellants state that Moslehi discloses that both the digermane gas and additives and the inert gases can flow through the plasma gas tube 24. (brief, page 8). Yet, appellants state that there is no mixing of (1) a nonplasma diluent gas flow and (2) a flow of reactive radicals, to form the gas-radical

[2] We find that these gases are the "diluent" gas flow.
[3] We find that these gases are the "reactive radicals".

mixture anterior to the chamber. Appellants have not explained why mixing of (1) a nonplasma diluent gas flow (which, in Moslehi, can be the flow of H_2, Ar/He (or other inert gas such as He or Xe), or an H_2 + Ar/He) and (2) a flow of reactive radicals (which, in Moslehi, can be the flow of the digermane gas and the HCl/HBr and HF additives) does not occur in Moslehi, in light of the disclosure at column 11, lines 37-44.

Furthermore, we find that discharge cavity 28 is anterior to chamber 14.[4] We note that appellants' claims 1 and 21 do not recite the type of radicals and gases that make-up these respective flows, and hence these claims are indistinguishable from Moslehi in this regard.

With regard to claims 4 and 5, we refer to footnote 2 and note that the diluent of Moslehi satisfy the requirements of claims 4 and 5, and thus affirm the rejection of these claims.

With respect to claim 7, the examiner states that Moslehi sets forth a ratio of at least 2:1 (answer page 9). The examiner refers to column 12, line 1 and to column 11, line 68 of Moslehi. On pages 3-4 of the reply brief, appellants argue that the disclosure relied upon by the examiner is in the context when the nonplasma gas flow is introduced into the afterglow of the plasma discharge inside the process chamber. We agree with appellants' observations made here. However, as discussed, supra, Moslehi indicates that some or all of the digermane gas and

[4]Both appellants and the examiner argue extensively about the meaning of the word "anterior". We simply note that appellants do not explain how discharge cavity 28 is not anterior to chamber 14. Given the fact it is located outside of chamber 14, we find that discharge cavity 28 is anterior to chamber 14.

additives can be introduced into the plasma stream. See column 11, lines 39-42. Following this teaching, along with the teaching of the amounts as set forth at column 11, lines 65 through column 12, line 1, we determine that these combined teachings would satisfy appellants' claim 7. Appellants have not explained why the selected amounts would differ if one would select to introduce the digermane gas and additives into discharge cavity 28. Hence, we **affirm** the rejection with respect to claim 7.

Turning now to apparatus claim 8, we refer to our discussion set forth supra, regarding means plus function claims, and incorporate the same reasoning here to warrant a **remand** to the examiner for a proper analysis.

In view of the above, we **affirm** the rejection of claims 1, 2, 3, 4, 5, 6, 7, and 21. We **remand** the application to the examiner with respect to claims 8-15.

III. 35 U.S.C. § 103 rejection

The examiner has rejected claims 16-20 under 35 U.S.C. § 103 as being unpatentable over Kawamura or Moslehi in view of Stevens.

The examiner relies upon Stevens for teaching the aspect of appellants' invention found in claim 16 regarding the use of microwave arrestors and apertures.

We note that claims 16-20 are apparatus claims. Claim 16 recites multiple elements, including a pump system, a mixing manifold having multiple inlets and other requirements, a controller, a memory, and a first subroutine. See the appendix attached herewith for a complete recitation of claim 16.

We determine that the examiner's rejection does not address these elements of claim 16. See, for example,

pages 4-5 of the office action of Paper No. 11. The examiner does discuss the teachings of Kawamura and Moslehi as to how each teaches and/or differs from these claimed elements. Moreover, the examiner does not provide reasons of why one skilled in the art would have incorporated the parts of Stevens' apparatus into the apparatus of either Kawamura or Moslehi, nor how one skilled in the art would do so. The examiner simply concludes that the reason for incorporation of the parts is "a common practice in the art". (office action of Paper No. 11, page 5). In doing so, we determine that the examiner has overlooked the principle that there must have been something present in the teachings to suggest to one skilled in the art that the claimed invention would have been obvious. In re Bergel, 292 F.2d 955, 956-57, 130 USPQ 206, 208 (CCPA 1961); In re Sponnoble, 405 F.2d 578, 585, 160 USPQ 237, 244 (CCPA 1969). Moreover, the examiner has overlooked the basic principle that obviousness under § 103 is a legal conclusion based upon facts revealing the scope and content of prior art, the differences between prior art and the claims at issue, the level of ordinary skill in the art, and objective evidence of nonobviousness. Graham v. John Deere Co., 86 S.Ct. 684, 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966). The examiner's rejection does not contain such an analysis. Therefore, we remand the application to the examiner for a proper analysis in this regard.

IV. Conclusion

We **reverse** the rejection of claims 1-4, 6, and 21 under 35 U.S.C. § 102(b) as being anticipated by Kawamura.

We **remand** the application to the examiner with respect to claims 8, 9, and 11-15 involved in this rejection.

We **affirm** the rejection of claims 1 through 7, and 21 under 35 U.S.C. § 102(b) as being anticipated by Moslehi. We **remand** the application to the examiner with respect to claims 8-15.

With regard to the rejection of claims 16-20 under 35 U.S.C. § 103 as being unpatentable over Kawamura or Moslehi in view of Stevens, we **remand** the application to the examiner.

We instruct that the application be remanded to the examiner, via the Office of the involved Technology Center, for appropriate action in view of our comments above as to the applicable claims.

This application, by virtue of its "special status," requires immediate action on the part of the examiner. See Manual of Patent Examining Procedure § 708.01 (7th ed., Rev. 1, Feb. 2000). It is important that the Board of Patent Appeals and Interferences by promptly informed of any action affecting the appeal in this case.

This action contains a **remand** to the examiner. This decision shall not be considered final for purposes of judicial review. 37 CFR § 1.196(e)(2000) provides that, "Whenever a decision of the Board of Patent Appeals and Interferences includes or allows a remand, that decision shall not be considered a final decision. When appropriate, upon conclusion of proceedings on remand before the examiner, the Board of Patent Appeals and Interferences may enter an order otherwise making its decision final".

No time period for taking any subsequent action in connection with appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART and REMANDED

Peter F. Kratz)
Administrative Patent Judge)
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)
Jeffrey T. Smith) BOARD OF PATENT
Administrative Patent Judge) APPEALS AND
) INTERFERENCES
)
)
Beverly A. Pawlikowski)
Administrative Patent Judge)

APPENDIX

1. A method of removing residue from a substrate processing chamber, said method comprising the steps of:

forming a plasma remotely with respect to said chamber, said plasma including a plurality of reactive radicals;

forming a flow of said reactive radicals traversing toward said chamber;

forming a nonplasma diluent gas flow;

mixing said flow of said reactive radicals and said diluent gas flow anterior to said chamber to form a gas-radical mixture; and

flowing said gas-radical mixture into said chamber.

2. The method as recited in claim 1 wherein said flow of reactive radicals and said gas flow are established to maintain a pressure within said chamber below one torr.

3. The method as recited in claim 1 wherein said reactive radicals comprise atoms associated with a reactive gas, with said reactive gas being selected from a group consisting of NF_3, dilute F_2, CF_4, C_2F_6, C_3F_8, SF_6, and ClF_3.

4. The method as recited in claim 1 wherein said diluent gas flow comprises an inert gas.

5. The method as recited in claim 1 wherein said diluent gas flow comprises a reduction gas.

6. The method as recited in claim 1 wherein said chamber has components therein, with a subset of said radicals in said gas-radical mixture reacting with said components creating a residue and further including the step of exhausting said residue, with a rate at which said residue is exhausted depending upon a rate of said diluent gas flow.

7. The method as recited in claim 1 wherein said diluent gas flow travels at a first rate and said flow of said reactive radicals travel at a second rate with a ratio of said first rate to said second rate being at least 2:1.

8. A substrate processing apparatus having a process chamber, said apparatus, comprising:

means for forming a plasma remotely with respect to said chamber, said plasma including a plurality of reactive radicals;

means, in fluid communication with said means for forming a plasma, for forming a flow of said reactive radicals traversing toward said chamber;

means for forming a nonplasma diluent gas flow;

means, in fluid communication with said means for forming a flow of said reactive radicals and with said means for forming a diluent gas flow, for mixing said flow of said reactive radicals and said diluent gas flow downstream of said means for forming a plasma and anterior to said chamber to form a gas-radical mixture; and

means, in fluid communication with said means for mixing, for flowing said gas-radical mixture into said chamber.

9. The apparatus as recited in claim 8 wherein said means for forming a diluent gas flow includes a supply of diluent gas and a pump system in fluid communication therewith, with said supply of diluent gas comprising a nonplasma inert gas.

10. The apparatus as recited in claim 8 wherein said diluent gas flow travels at a first rate and said flow of said reactive radicals travel at a second rate with a ratio of said first rate to said second rate being at least 2:1.

11. The apparatus as recited in claim 9 wherein said supply of diluent gas comprises a reducing gas.

12. The apparatus as recited in claim 8 wherein said means for forming a plasma includes a plasma applicator defining an internal volume and a supply of reactive gas in fluid communication with said internal volume, with said supply of reactive gas being selected from a group consisting of NF_3, dilute F_2, CF_4, C_2F_6, C_3F_8, SF_6, and $C1F_3$.

13. The apparatus as recited in claim 12 wherein said plasma applicator includes a microwave source in electrical communication with said plasma applicator.

14. The apparatus as recited in claim 9 wherein said pump system maintains a pressure within said chamber below one torr.

15. The apparatus as recited in claim 9 wherein said inert gas is argon.

16. A substrate processing apparatus, comprising:

a processing chamber having an intake port;

a supply of nonplasma diluent gas;

a plasma source for generating a plasma consisting a reactive radials, said plasma source including a conductive plasma applicator defining an internal volume, said applicator having an input aperture and an output aperture, each of which is equipped with microwave arrestors;

a mixing manifold having multiple inlets and an outlet with said outlet being coupled to said intake port and one of said inlets being in fluid communication with said outlet aperture of said conductive plasma applicator, with the remaining inlets being in fluid communication with said supply of diluent gas;

a pump system, in fluid communication with both said plasma source and said supply of diluent gas, to create a diluent gas flow and a flow of said reactive radicals, with said flow of said reactive radicals traversing said output aperture toward said mixing manifold and said flow of gas traveling from said supply to said mixing manifold, with said diluent gas flow and said flow of said reactive radicals combining when traveling between said inlets and

said outlet forming a gas-radical mixture egressing from said outlet and traversing through said intake port;

a controller configured to regulate said pump system and said plasma source; and

a memory, coupled to said controller, comprising a computer-readable medium having a computer-readable program embodied therein for directing operation of said substrate processing system, said computer-readable program including a set of computer instructions to be operated on by said controller to regulate the introduction of said radicals from said plasma into said mixing manifold, said set of computer instructions including:

a first subroutine to be operated on by said controller to regulate said pump system to introduce said reactive radicals into said mixing manifold at a first rate and said diluent gas at a second rate so as to maintain a pressure with said chamber less than one torr.

17. The apparatus of claim 16 wherein said first rate is in the range of 200 and 400 sccm and said second rate is in the range of 500 and 800 sccm.

18. The apparatus of claim 16 further including a gas delivery system in fluid communication with said plasma applicator to transmit a reactive gas thereto, with said controller being configured to regulate gas delivery system, wherein said set of computer instructions further includes a second subroutine instructions to be operated on by said controller to regulate said gas delivery system to introduce said reactive gas at a first rate to said gas inlet during a first time period at a first flow rate a third subroutine of computer instructions for controlling said pump system to maintain a pressure of about 1-20 torr within said applicator during said first time period.

19. The apparatus of claim 16 further including a microwave source in electrical communication with said plasma applicator, with said controller being configured to regulate said microwave source, wherein said set of computer instructions further includes a fourth subroutine to be operated on by said controller to regulate said microwave source to direct microwaves into said internal volume of said applicator during said first time period.

20. The apparatus of claim 19 wherein said fourth subset of computer instructions controls said remote microwave plasma system to direct said microwave energy at a power level ranging from about 150-500 W to ignite said plasma in said applicator.

21. A method of removing residue from a substrate processing chamber, said method comprising:

forming a flow of reactive radicals generated in a remote plasma outside of said chamber;

forming a nonplasma gas flow:

mixing said flow of said reactive radicals and said nonplasma gas flow anterior to said chamber to form a gas-radical mixture; and

flowing said gas-radical mixture into said chamber.

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